Utility and Vulnerability Ranking Programs for Terrestrial Vertebrates

Introduction

- To assist decision makers in risk assessments, two sets of indices have been developed to rank terrestrial vertebrates for their utility in biomonitoring and susceptibility to the following contaminants:
    - Persistent Organic Pollutants
    - Cholinesterase-Inhibiting Pesticides
    - Petroleum Crude Oil
    - Mercury
    - Lead Shot
- The Utility Indices rank the suitability of terrestrial vertebrate species as potential sentinels of exposure to contaminants in a region.
- The Vulnerability Indices rank susceptibility of populations upon exposure to contaminants in a region.
- The Utility and Vulnerability Indices can be applied to many types of habitats and can be of value to natural resource managers that routinely conduct local, regional, or national environmental quality assessments.
- Frequently Ask Questions
    - What do the scores mean?
    - What if I do not know the answer to a question?
    - How many species should I rank before I pick one?
    - What if I disagree with the rankings I obtained?
- Contact us

Instructions

1. For the index of choice, select and enter the name of a species found in your study area.
2. Answer each question about the selected species to the best of your knowledge, as it relates to your study area and the season in which you intend to perform the monitoring.
    - When necessary, use the links provided to obtain more information about your species.
3. Click the “calculate” button to display your index score.
    - Remember, the score itself has no inherent meaning as results for any one species will change among study areas, seasons, and investigators. The program is designed to rank two or more species when compared under similar conditions.
4. Reset the form and return to the top by clicking “clear all inputs”.
5. Repeat for one or more species. The program will automatically list the score of each species, and rank them in numerical order.

For more information on these indices, and interspecific contaminant exposure and sensitivity in terrestrial vertebrates, see:

Golden, N.H. and B.A. Rattner. 2003. Ranking terrestrial vertebrate species for utility in biomonitoring and vulnerability to environmental contaminants. Reviews in Environmental Contamination and Toxicology. 176:67-136. (Feel free to contact us to request a copy)

UTILITY INDICES

The Utility Indices rank the suitability of terrestrial vertebrate species as potential sentinels of exposure to contaminants in a region.

Components of Utility Indices:

1. Exposure Potential

A measure of the likelihood of an individual encountering a contaminant by oral, dermal, or inhalation routes of exposure.

Specific elements that may affect exposure may include dietary preference, habitat preference, longevity, foraging technique, and other behaviors that result in contact with the physical environment.

Elements for exposure potential will vary among Utility indices.

2. Geographic Occurrence

The range and seasonal occurrence within a particular study area.

Species that are considered more desirable for monitoring occur throughout a greater portion of the study area, spend a greater amount of their life cycle in the study area, and breed, rather than just winter, in the study area.

3. Ease of Collection

Ease of collection is determined by a species' social structure, accessibility, ease of capture, abundance, and management status. The season during which the collection will occur may influence results (e.g., a population may be highly colonial during the breeding season, yet employ a looser social structure during winter months)

Accessibility is classified in relative terms, simply as "easy," "moderate," or difficult." These loosely defined terms permit users to rate accessibility based on the specific circumstance, taking into account monetary, personnel, equipment, and other logistical constraints.

Abundance and management status includes restrictions on collection or disturbance based upon state or federal regulations protection measures or management protocols.

Species are considered easier to collect if they nest or roost colonially and breed in the study area, making collections of eggs or young for contaminant or biomarker analysis possible (persistent organic pollutants, mercury, and cholinesterase-inhibiting pesticides only).

4. Quantity of Existing Exposure and Effects Data

The amount of information available for a species in regard to the particular contaminant or contaminant class. Data sources may include hypothesis-driven laboratory or field investigations, or other types of monitoring efforts. Species for which relatively greater amounts of data exist for the contaminant of concern are given more weight as sentinels. The existence of baseline data and historical precedent are considered advantageous for bioindicator species in that such data facilitates comparison to affected conditions.

5. Calculation of Utility Index Scores

The four components are summed, each carrying equal weight regardless of the number of elements:

Utility Index Score = (Exposure Potential) + (Geographic Occurrence) + (Ease of Collection) + (Quantity of Existing Data)

Each component carries a value between 1 and 5 points. Elements within components are weighted equally (1-5 points), with the exception of “Dietary Preference” and “Foraging Technique” within the Exposure Potential component, which carry a maximum value of 10 points. These two elements are weighted more heavily as they generally represent the principal route of toxicant exposure for terrestrial vertebrates. The final Utility Index score ranges between 4 and 20

Roll over the Index Name with your mouse for specific point values of each element in the table below.

Utility Index	Equation
POPs	$\frac{(A1+A2+A3)}{4}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4+C5)}{5}+(D1)$
ChE Inhibiting Pesticides	$\frac{(A1+A2)}{3}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4+C5)}{5}+(D1)$
Petroleum	$\frac{(A1+A2+A3+A4+A5+A6)}{6}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4+C5)}{5}+(D1)$
Mercury	$\frac{(A1+A2+A3)}{4}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4+C5)}{5}+(D1)$
Lead Shot	$\frac{(A1+A2+A3+A4)}{5}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4+C5)}{5}+(D1)$

VULNERABILITY INDICES

The Vulnerability Indices rank susceptibility of populations upon exposure to contaminants in a region.

Components of Vulnerability Indices:

1. Exposure Potential

A measure of the likelihood of an individual encountering a contaminant by oral, dermal, or inhalation routes of exposure.

Specific elements that may affect exposure of both the individual and population may include: dietary preference, habitat preference, longevity, foraging technique, other behaviors that result in contact with the environment, amount of time spent on the study area, and distribution throughout the study area.

Elements of individual exposure potential (e.g., dietary and habitat preference, longevity, foraging technique) will vary among Vulnerability indices. Elements that affect the exposure of the population (i.e., time spent in study area, distribution throughout study area) will remain the same among Vulnerability Indices.

2. Sensitivity

An individual's likelihood to sustain damage from exposure to a contaminant. Elements of sensitivity will differ among Vulnerability Indices based partially on the mechanism of action of the toxicant.

3. Resilience of a population

The ability to recover following a harmful exposure, based on: abundance within and outside the study area, reproductive potential, and age of individuals at first breeding.

4. Calculation of Vulnerability Index Scores

The three components are summed, giving more weight to the first component
o It is assumed that if a species is unlikely to be exposed, it is not highly vulnerable regardless of individual sensitivity or population resilience

Vulnerability Index Score = 2 (Exposure Potential) + (Sensitivity) + (Resilience of Population)

Elements within components are weighted equally (1-5 points), with the exception of "Dietary Preference" and "Foraging Technique" within the Exposure Potential component, which carry a maximum value of 10 points. These elements are weighted more heavily as they generally represent the principal route of toxicant exposure for terrestrial vertebrates. The Vulnerability Index yields a score between 4 and 20

Roll over the Index Name with your mouse for specific point values of each element in the table below.

Vulnerability Index Equations
POPs
$\frac{2(A1+A2+A3+A4+A5+A6)}{7}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4)}{4}$
ChE Inhibiting Pesticides
$\frac{2(A1+A2+A3+A4+A5+A6)}{6}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4)}{4}$
Petroleum
$\frac{2(A1+A2+A3+A4+A5+A6+A7+A8+A9)}{9}+\frac{(B1+B2+B3)}{3}+\frac{(C1+C2+C3+C4)}{4}$
Mercury
$\frac{2(A1+A2+A3+A4+A5+A6)}{7}+(B1)+\frac{(C1+C2+C3+C4)}{4}$
Lead Shot
$\frac{2(A1+A2+A3+A4+A5+A6)}{7}+\frac{(B1+B2)}{2}+\frac{(C1+C2+C3+C4)}{4}$

HOW TO CITE THIS DOCUMENT

Please use the following citation when referring to this document:

Golden, N.H., B.A. Rattner, and J.B. Cohen. 2003. Ranking Terrestrial Vertebrate Species for Utility in Biomonitoring and Vulnerability to Environmental Contaminants. [Updated July 2003; cited *]. U.S. Geological Survey, Patuxent Wildlife Research Center, Laurel, Maryland. Available from: http://www.pwrc.usgs.gov/ceetv/

* enter the date you actually visited the website

Persistent Organic Pollutants Utility Index

A. EXPOSURE POTENTIAL

1. Primary Dietary Preference

10—Fish or moderately-sized terrestrial vertebrates
8—Small terrestrial vertebrates
6—Invertebrates
4—Both animals and vegetation (omnivore)
1—Vegetation

2. Longevity

5—Long-lived (>15 years)
3—5-15 years
1—Short-lived (<5 years)

3. Use of agricultural, industrial, or urbanized areas

5—Readily inhabits and/or forages in these areas
3—Occasionally utilizes these areas
1—Avoids these areas

B. GEOGRAPHIC OCCURRENCE

1. Range

5—Present throughout entire study area
4—Present throughout more than half of study area
3—Present throughout about half of study area
2—Present throughout less than half of study area
1—Present in small part of study area only

2. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

C. EASE OF COLLECTION

1. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

2. Accessibility of sampling unit

5—Individuals or nests are easily accessible
3—Individuals or nests are moderately accessible
1—Individuals or nests are difficult to access

3. Ease of capture

5—Low mobility (e.g., nestbound young or eggs available)
3—Moderate mobility (e.g., independently-foraging young)
1—High mobility (e.g., only mobile adults available)

4. Abundance in study area

5—Abundant (Numerous in suitable habitat)
4—Common (Certain to be in suitable habitat)
3—Uncommon (Presence expected, but not a certainty)
2—Occasional (Presence possible, but not expected)
1—Rare (Not normally present)

5. Federal or state management status in study area

5—Not protected or managed
4—Protected
3—Threatened
1—Endangered

D. QUANTITY OF EXISTING EXPOSURE AND EFFECTS DATA

5—Substantial data
3—Some data
1—Very little data

Back to Utility Index Box

Cholinesterase-Inhibiting Pesticides Utility Index

A. EXPOSURE POTENTIAL

1. Primary Dietary Preference

10—Terrestrial vegetation
8—Terrestrial invertebrates
6—Predator or scavenger of terrestrial vertebrates
4—Both aquatic and terrestrial plants and animals
1—Aquatic plants and animals

2. Use of treated agricultural and suburban areas, or golf courses

5—Readily inhabits or forages in these areas
3—Will occasionally inhabit or forage in these areas
1—Avoids these areas

B. GEOGRAPHIC OCCURRENCE

1. Range

5—Present throughout entire study area
4—Present throughout more than half of study area
3—Present throughout about half of study area
2—Present throughout less than half of study area
1—Present in small part of study area only

2. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area

3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

C. EASE OF COLLECTION

1. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

2. Accessibility of sampling unit

5—Individuals or nests are easily accessible
3—Individuals or nests are moderately accessible
1—Individuals or nests are difficult to access

3. Ease of capture

5—Low mobility (e.g., nestbound young available)
3—Moderate mobility (e.g., independently-foraging young)
1—High mobility (e.g., mobile adults available only)

4. Abundance in study area

5—Abundant (Numerous in suitable habitat)
4—Common (Certain to be in suitable habitat)
3—Uncommon (Presence expected, but not a certainty)
2—Occasional (Presence possible, but not expected)
1—Rare (Not normally present)

5. Federal or state management status in study area

5—Not protected
4—Protected (managed population)
3—Threatened
1—Endangered

D. QUANTITY OF EXISTING EXPOSURE AND EFFECTS DATA

5—Substantial data
3—Some data
1—Very little data

Back to Utility Index Box

Petroleum Crude Oil Utility Index

A. EXPOSURE POTENTIAL

1. Time spent on or in water

5—Nearly always
4—Most of the time
3—Half of the time

2—Less than half of time
1—Seldom or never

2. Escape behavior

5—Dives
4—Swims, but sometimes dives
3—Swims
2—Flies, but sometimes swims
1—Flies

3. Primary foraging technique

5—Dives or is submersed in water
4—Dabbles in water
3—Probes mud or stalks
2—Skims surface of water
1—Does not forage in water

4. Preening or grooming behavior

5—Preens or grooms feathers or fur
1—Does not preen or groom

5. Exposure of eggs

5—Eggs laid in water
4—Eggs laid near water
3—Eggs laid away from water, transfer from adult likely (e.g., waterbirds)
2—Eggs laid away from water, transfer from adult not likely (e.g., turtles, terrestrial birds)
1—Does not lay eggs or does not breed in study area

6. Use of urbanized areas or shipping channels

5—Readily inhabits and/or forages in these areas
3—Occasionally utilizes these areas
1—Avoids these areas

B. GEOGRAPHIC OCCURRENCE

1. Range

5—Present throughout entire study area
4—Present throughout more than half of study area
3—Present throughout about half of study area
2—Present throughout less than half of study area
1—Present in small part of study area only

2. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

C. EASE OF COLLECTION

1. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

2. Accessibility of sampling unit

5—Individuals or nests are easily accessible
3—Individuals or nests are moderately accessible
1—Individuals or nests are difficult to access

3. Ease of capture or trappability

5—Easy to capture or trap
3—Moderate
1—Difficult

4. Abundance in study area

5—Abundant (Numerous in suitable habitat)
4—Common (Certain to be in suitable habitat)
3—Uncommon (Presence expected, but not a certainty)
2—Occasional (Presence possible, but not expected)
1—Rare (Not normally present)

5. Federal or state management status in study area

5—Not protected
4—Protected (managed population)
3—Threatened
1—Endangered

D. QUANTITY OF EXISTING EXPOSURE AND EFFECTS DATA

5—Substantial data
3—Some data
1—Very little data

Back to Utility Index Box

Mercury Utility Index

A. EXPOSURE POTENTIAL

1. Primary Dietary Preference

10—Fish
8—Terrestrial vertebrates or aquatic invertebrates
6—Both vegetation and animals (aquatic or semi-aquatic omnivore)
4—Both vegetation and animals (terrestrial omnivore)
1—Vegetation

2. Longevity

5—Long-lived (>15 years)
3—5-15 years
1—Short-lived (<5 years)

3. Use of industrial or urbanized areas, and areas vulnerable to acid precipitation

5—Readily inhabits or forages in these areas
3—Will occasionally utilize these areas
1—Avoids these areas

B. GEOGRAPHIC OCCURRENCE

1. Range

5—Present throughout entire study area
4—Present throughout more than half of study area
3—Present throughout about half of study area
2—Present throughout less than half of study area
1—Present in small part of study area only

2. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

C. EASE OF COLLECTION

1. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

2. Accessibility of sampling unit

5—Individuals or nests are easily accessible
3—Individuals or nests are moderately accessible
1—Individuals or nests are difficult to access

3. Ease of capture

5—Low mobility (e.g., nestbound young or eggs available)
3—Moderate mobility (e.g., independently-foraging young)
1—High mobility (e.g., mobile adults available only)

4. Abundance in study area

5—Abundant (Numerous in suitable habitat)
4—Common (Certain to be in suitable habitat)
3—Uncommon (Presence expected, but not a certainty)
2—Occasional (Presence possible, but not expected)
1—Rare (Not normally present)

5. Federal or state management status in study area

5—Not protected or managed
4—Protected
3—Threatened
1—Endangered

D. QUANTITY OF EXISTING EXPOSURE AND EFFECTS DATA

5—Substantial data
3—Some data
1—Very little data

Back to Utility Index Box

Lead Utility Index

A. EXPOSURE POTENTIAL

1. Primary foraging technique

10—Dives under water, feeds off bottom
8—Dabbles under water, feeds off bottom
7—Ground gleaner
5—Probes below surface, long bill length (>5 cm)
4—Probes below surface, short bill length (<5 cm)
1—Does not feed in any of these manners

2. Dietary preference

5—Predator or scavenger of (waterfowl)
3—Predator or scavenger of other game species
1—Does not feed in this manner

3. Use of hunted areas

5—Readily inhabits or forages in hunted areas
3—Occasionally inhabits or forages in hunted areas
1—Does not generally utilize hunted areas

4. Longevity

5—Long-lived (>15 years)
3—5-15 years
1—Short-lived (<5 years)

B. GEOGRAPHIC OCCURRENCE

1. Range

5—Present throughout entire study area
4—Present throughout more than half of study area
3—Present throughout about half of study area
2—Present throughout less than half of study area
1—Present in small part of study area only

2. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

C. EASE OF COLLECTION

1. Population concentration

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

2. Accessibility of sampling unit

5—Individuals or nests are easily accessible
3—Individuals or nests are moderately accessible
1—Individuals or nests are difficult to access

3. Ease of capture or trappability

5—Easy to capture or trap
3—Moderate
1—Difficult

4. Abundance in study area

5—Abundant (Numerous in suitable habitat)
4—Common (Certain to be in suitable habitat)
3—Uncommon (Presence expected, but not a certainty)
2—Occasional (Presence possible, but not expected)
1—Rare (Not normally present)

5. Federal or state management status in study area

5— Not protected or managed
4—Protected (managed population)
3—Threatened
1—Endangered

D. QUANTITY OF EXISTING EXPOSURE AND EFFECTS DATA

5—Substantial data
3—Some data
1—Very little data

Back to Utility Index Box

Persistent Organic Pollutants Vulnerability Index

A. EXPOSURE POTENTIAL

1. Primary Dietary Preference

10—Fish or moderately-sized terrestrial vertebrates
8—Small terrestrial vertebrates
6—Invertebrates
4—Both animals and vegetation (omnivore)
1—Vegetation

2. Longevity

5—Long-lived (>15 years)
3—5-15 years
1—Short-lived (<5 years)

3. Use of agricultural, industrial, or urbanized areas

5—Readily inhabits and/or forages in these areas
3—Occasionally utilizes these areas
1—Avoids these areas

4. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1— Transient (present during migration only)

5. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

6. Range

5—Present in small part of study area only
4—Present throughout less than half of study area
3—Present throughout about half of study area
2—Present throughout more than half of study area
1—Present throughout entire study area

B. SENSITIVITY

1. Feeding specialization

5—Highly specialized
4—Somewhat specialized
3—Moderately adaptable
2—Very adaptable
1—Generalist

2. Ability to metabolize and clear POPs

5—Low (fish-eating birds)
3—Moderate (other birds and mammals, reptiles)
1—High (rodents and lagomorphs, gallinaceous birds)

C. RESILIENCE OF POPULATION

1. Abundance in study area

5—Rare (Not normally present)
4—Occasional (Presence possible, but not expected)
3—Uncommon (Presence expected, but not a certainty)
2—Common (Certain to be in suitable habitat)
1—Abundant (Numerous in suitable habitat)

2. Distribution outside of study area

5—Endemic to study area
3—Present outside of study area, but not abundant
1—Abundant outside of study area

3. Reproductive potential

5—Low (1-2 offspring per year)
3—Moderate (3-4 offspring per year)
1—High (>4 offspring per year)

4. Age at first breeding

5—6+ years
4—5 years
3—4 years
2—3 years
1—1-2 years

Back to Vulnerability Index Box

Cholinesterase-Inhibiting Pesticides Vulnerability Index

A. EXPOSURE POTENTIAL

1. Primary dietary preference

10—Terrestrial vegetation
8—Terrestrial invertebrates
6—Predator or scavenger of terrestrial vertebrates
4—Both aquatic and terrestrial plants and animals
1—Aquatic plants and animals

2. Use of agricultural and suburban areas, or golf courses

5—Readily inhabits or forages in these areas
3—Will occasionally inhabit or forage in these areas
1—Avoids these areas

3. Residency

5—Year-round resident (does not migrate)
4—Migrates within stsudy area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

4. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

5. Range

5—Present in small part of study area only
4—Present throughout less than half of study area

3—Present throughout about half of study area
2—Present throughout more than half of study area
1—Present throughout entire study area

B. SENSITIVITY

1. Feeding specialization

5—Highly specialized
4—Somewhat specialized
3—Moderately adaptable
2—Very adaptable
1—Generalist

2. Ability to metabolize and clear Ops

5—Low (fish-eating birds)
3—Moderate (other birds and mammals, reptiles)
1—High (rodents and lagomorphs, gallinaceous birds)

C. RESILIENCE OF POPULATION

1. Peak abundance in study area during season of concern

5—Rare (Not normally present)
4—Occasional (Presence possible, but not expected)
3—Uncommon (Presence expected, but not a certainty)
2—Common (Certain to be in suitable habitat)
1—Abundant (Numerous in suitable habitat)

2. Distribution outside of study area

5—endemic to study area
3—present outside of study area, but not abundant
1—abundant outside of study area

3. Reproductive potential

5—Low (1-2 offspring per year)
3—Moderate (3-4 offspring per year)
1—High (>4 offspring per year)

4. Age at first breeding

5—6+ years
4—5 years
3—4 years
2—3 years
1—1-2 years

Back to Vulnerability Index Box

Petroleum Crude Oil Vulnerability Index

A. EXPOSURE POTENTIAL

1. Time spent on or in water

5—Nearly always
4—Most of the time
3—Half of the time
2—Less than half of time
1—Seldom or never

2. Escape behavior

5—Dives
4—Swims, but sometimes dives
3—Swims
2—Flies, but sometimes swims
1—Flies

3. Primary foraging technique

5—Dives or is submersed in water
4—Dabbles in water
3—Probes mud
2—Skims surface of water
1—Does not forage in water

4. Preening or grooming behavior

5—Preens or grooms feathers or fur
1—Does not preen or groom

5. Exposure of eggs

5—Eggs laid in water
4—Eggs laid near water
3—Eggs laid away from water, transfer from adult likely (e.g., waterbirds)
2—Eggs laid away from water, transfer from adult not likely (e.g., turtles, terrestrial birds)
1—Does not lay eggs or does not breed in study area

6. Use of urbanized areas or shipping channels

5—Readily inhabits and/or forages in these areas
3—Occasionally utilizes these areas
1—Avoids these areas

7. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

8. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

9. Range

5—Present in small part of study area only
4—Present throughout less than half of study area
3—Present throughout about half of study area
2—Present throughout more than half of study area
1—Present throughout entire study area

B. SENSITIVITY

1. Effect of oil on waterproofing/insulation

5—Difficult to regain waterproofing/ insulation
(cormorants, diving ducks, most mammals)
3—Able to regain waterproofing
(shore birds, upland birds, other ducks)
1—Waterproofing/insulation not greatly affected
(reptiles, amphibians, seals, seas lions, cetaceans)

2. Feeding specialization

5—Highly specialized
4—Somewhat specialized
3—Moderately adaptable
2—Very adaptable
1—Generalist

3. Ability to metabolize and clear hydrocarbons

5—Low (fish-eating birds)
3—Moderate (other birds and mammals, reptiles)
1—High (rodents and lagomorphs, gallinaceous birds)

C. RESILIENCE OF POPULATION

1. Abundance in study area

5—Rare (Not normally present)
4—Occasional (Presence possible, but not expected)
3—Uncommon (Presence expected, but not a certainty)
2—Common (Certain to be in suitable habitat)
1—Abundant (Numerous in suitable habitat)

2. Distribution outside of study area

5—Endemic to study area
3—Present outside of study area, but not abundant
1—Abundant outside of study area

3. Reproductive potential

5—Low (1-2 offspring per year)
3—Moderate (3-4 offspring per year)
1—High (>4 offspring per year)

4. Age at first breeding

5—6+ years
4—5 years
3—4 years
2—3 years
1—1-2 years

Back to Vulnerability Index Box

Mercury Vulnerability Index

A. EXPOSURE POTENTIAL

1. Primary Dietary Preference

10—Fish
8—Terrestrial vertebrates or aquatic invertebrates
6—Both aquatic vegetation and animals (aquatic or semi-aquatic omnivore)
4—Both vegetation and animals (terrestrial omnivore)
1—Vegetation

2. Use of industrial or urbanized areas, and areas vulnerable to acid precipitation

5—Readily inhabits or forages in these areas
3—Will occasionally utilize these areas
1—Avoids these areas

3. Longevity

5—Long-lived (>15 years)
3—5-15 years
1—Short-lived (<5 years)

4. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

5. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

6. Range

5—Present in small part of study area only
4—Present throughout less than half of study area
3—Present throughout about half of study area
2—Present throughout more than half of study area
1—Present throughout entire study area

B. SENSITIVITY

1. Molt

5—Does not molt
3—Molts infrequently (interval of complete molt =1 year)
1—Molts frequently (interval of complete molt <1 year)

C. RESILIENCE OF POPULATION

1. Abundance in study area

5—Rare (Not normally present)
4—Occasional (Presence possible, but not expected)
3—Uncommon (Presence expected, but not a certainty)
2—Common (Certain to be in suitable habitat)
1—Abundant (Numerous in suitable habitat)

2. Distribution outside of study area

5—endemic to study area
3—present outside of study area, but not abundant
1—abundant outside of study area

3. Reproductive potential

5—Low (1-2 offspring per year)
3—Moderate (3-4 offspring per year)
1—High (>4 offspring per year)

4. Age at first breeding

5—6+ years
4—5 years
3—4 years
2—3 years
1—1-2 years

Back to Vulnerability Index Box

Lead Vulnerability Index

A. EXPOSURE POTENTIAL

1. Primary foraging technique

10—Dives under water, feeds off bottom
8—Dabbles under water, feeds off bottom
7—Ground gleaner
5—Probes below surface, long bill length (>5 cm)
4—Probes below surface, short bill length (<5 cm)
1—Does not feed in any of these manners

2. Dietary preference

5—Predator or scavenger of (waterfowl)
3—Predator or scavenger of other game species
1—Does not feed in this manner

3. Use of hunted areas

5—Readily inhabits or forages in hunted areas
3—Occasionally inhabits or forages in hunted areas
1—Does not generally utilize hunted areas

4. Residency

5—Year-round resident (does not migrate)
4—Migrates within study area
3—Migrates beyond study area (present during breeding)
2—Migrates beyond study area (present during winter)
1—Transient (present during migration only)

5. Social structure

5—Highly colonial or gregarious
3—Semi-colonial or semi-gregarious
1—Solitary

6. Range

5—Present in small part of study area only
4—Present throughout less than half of study area
3—Present throughout about half of study area
2—Present throughout more than half of study area
1—Present throughout entire study area

B. SENSITIVITY

1. Proportion of protein or calcium in diet

5—Low (mostly vegetation)
3—Moderate
1—High (animal matter, mollusks)

2. Dietary preference

5—Granivorous
4—Insectivores
3—Omnivorous
2—Frugivorous
1—Carnivorous

3. Relative Body Size

5—Small (e.g., passerines)
3—Medium (e.g., most waterfowl, gulls)
1—Large (e.g., geese, larger raptors)

C. RESILIENCE OF POPULATION

1. Peak abundance in study area during season of concern

5—Rare (Not normally present)
4—Occasional (Presence possible, but not expected)
3—Uncommon (Presence expected, but not a certainty)

2—Common (Certain to be in suitable habitat)
1—Abundant (Numerous in suitable habitat)

2. Distribution outside of study area

5—endemic to study area
3—present outside of study area, but not abundant
1—abundant outside of study area

3. Reproductive potential

5—Low (1-2 offspring per year)
3—Moderate (3-4 offspring per year)
1—High (>4 offspring per year)

4. Age at first breeding

5—6+ years
4—5 years
3—4 years
2—3 years
1—1-2 years

Back to Vulnerability Index Box

Frequently Asked Questions

What do the scores mean?

The numbers themselves have no inherent meaning; they are used only to rank one species against another. A higher Utility score indicates that a species is more useful in biomonitoring; a higher Vulnerability score indicates that a population has greater susceptibility.

What if I don't know the answer to a question?

The program will not allow you to leave a question blank, so if you've consulted with the suggested websites and still don't know the answer, take your best guess. Remember, the scores are not absolute but relative values that will change for every species, study area, and/or user.

How many species should I rank before I pick one?

Since every situation is different, it's up to you. Presumably, you will already have some ideas about your study area and project before you use the ranking programs. The Utility and Vulnerability Indices can help you hone and focus these ideas.

What if I disagree with the rankings I obtained?

Ultimately you must rely on your own judgment. While the ranking programs are written to be general in order to apply to many species and study areas, they cannot take into account every situation. Please use them as one of several tools in your decision-making process.

Didn't find the answer to your question?

Contact Us

Back to the top